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Gender Implications in Curriculum and Entrance Exam Grouping

Institutional Factors and Their Effects

Abstract: While access to higher education has reached gender parity in Taiwan, the phenomenon of gender segregation and stratification by fields of study and by division of labor persist. In this article, we trace the historical evolution of Taiwan's education system and data using large-scale educational databases to analyze the association of institutional factors and educational outcomes. Grouping in the college entrance examinations in the 1950s led to grouping in the high school curriculum, which, in turn, seems to have enlarged the mathematics performance gap between the natural sciences group and the social studies group, and extended to a performance gap between the two groups on the college entrance examination. Because men concentrate in science and engineering and women concentrate in humanities, the superiority of the former disciplines over the latter was consolidated along with the stereotype that male fields were better than female fields.

Higher education has expanded since the second half of the twentieth century in most industrialized societies. Educational opportunities for men and women have been gradually equalizing. In terms of disciplines of study, however, there is still a significant gender gap in which “men study sciences and women study

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humanities.” Taiwan is no exception. Among university students in school in 2006, 336,524 women were studying the humanities and social sciences, or 68.17 percent of all students enrolled in those disciplines. In the natural sciences, however, there were only 141,204 women, accounting for 29.86 percent of the total (Ministry of Education [MOE], 2007).

Why has the gender gap not receded as higher education has expanded? In addition to the influence of cultural beliefs in traditional gender roles and gender stereotypes on students’ choices, Taiwan’s education system has also played an important role. This article focuses on exploring the evolution and role of the education system in this phenomenon. We examine the effect of the college entrance examination system on the high school curriculum grouping system. Using a panel survey data from the Taiwan Education Panel Survey (TEPS),¹ we analyze the associations between high school curriculum grouping and student learning, and using a survey of college freshmen students in the Taiwan Higher Education Database to discuss the inequity implications of the gender gap phenomenon in higher education.

Historical Overview

Grouping in the College Entrance Exam and High School Curriculum

In earlier years, some of Taiwan’s universities and colleges were single-sex. For example, Tatung Institute of Technology accepted only male students and Ming Chuan College of Business enrolled only women. Other colleges accepted both men and women, including National Taiwan University and National Chengchi University, but the majority of students were male. To avoid too great a disparity in the gender ratio, some colleges set different entrance exam score thresholds for men and women applying in the same departments, indicating that the entrance exam system has had a certain relationship to the gender gap phenomenon in higher education.²

Taiwan did not have many universities and colleges in the 1950s. Changes occurred over the years. At first, universities admitted students independently, then public universities conducted joint admission procedures, and private colleges and universities as well as military academies together had joint admissions. In 1954, the public university entrance examinations began to place students in three admission groups, A, B, and C. This in turn affected the high school curriculum.

In fact, in 1950 the Ministry of Education enacted secondary curriculum standards stipulating that high school students were not to be grouped. But grouping in the college entrance exams in 1954 created confusion in the area of high school instruction. In 1958, the Secondary Education Division of the MOE surveyed 124 senior high schools, asking whether their curriculum should be taught in groups focusing on natural sciences and social studies. More than half of the schools at the

time (64) advocated grouping (MOE 1960a). The MOE therefore recommended in its 1959 *Secondary School Curriculum Revision Opinion Report* that, beginning in the second year of senior high school (eleventh grade), the curriculum be divided into two groups, vocational and college bound. The college-bound group would then be further divided into social study groups and natural sciences groups (MOE 1960b).

In 1966, Taiwan's college entrance examination system implemented a division into four testing groups.³ In 1984 it was adjusted again to the current four category groups, each having a particular emphasis in the subjects tested.⁴ Grouping in the high school curriculum became more institutionalized as a result.⁵ The MOE revised the high school curriculum outline in 1996, abolishing the curriculum grouping system; students in the first and second years of high school (tenth and eleventh grades) now have exactly the same curriculum content, and elective courses are available only in the third year (twelfth grade). Nevertheless, the vast majority of senior high schools still begin grouping their instruction in year two and some as early as year one.

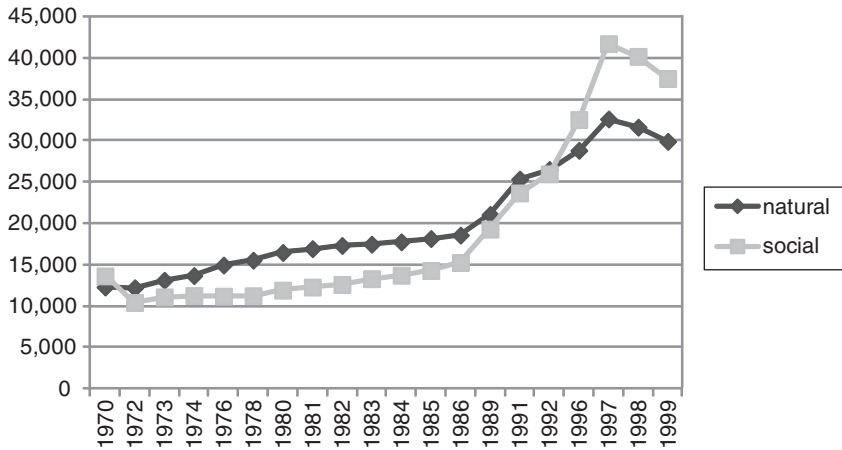
As senior high school curriculum grouping has become institutionalized, stratification among the groups has occurred. In 1973, Taipei's municipal Department of Education "received an accusatory letter from a parent, alleging that, to increase college-bound rates, some of the city's senior high schools had forcibly placed students with lower scores in the social studies group, and did not allow them to choose the natural sciences group, when grouping students in the second or third year of high school" (*Lianhe bao* 1973). The Department therefore ordered all senior high schools in the city to allow students to freely choose which group to enroll in, and disallowed compulsory grouping. This information suggests that there is more intense competition for the natural sciences group, but the latter also has a higher college admission rate. Therefore, schools view the natural sciences group as having higher status than the social studies group. How does senior high school grouping relate to admission rates in the college entrance examination? We consider this area below.

Grouping in the College Entrance Exams and in High School Instruction: Who Is Hindered? Who Is Advantaged?

In 1990, *Lianhe bao* reported that the college admission rate for the social studies group was less than two-thirds that of the natural sciences group—only 26 percent for Category 1, but as high as 62 percent for Categories 2, 3, and 4. Some parents demanded an increased admissions quota for Category 1. An official from the MOE responded, however, that:

The number admitted from each category is set based on society's human resources needs . . . now the numbers in the arts, law, and commerce disciplines at universities are maintaining a ratio of about 1:1 with the science, engineering,

Figure 1. Numbers Admitted Through the College Entrance Exam



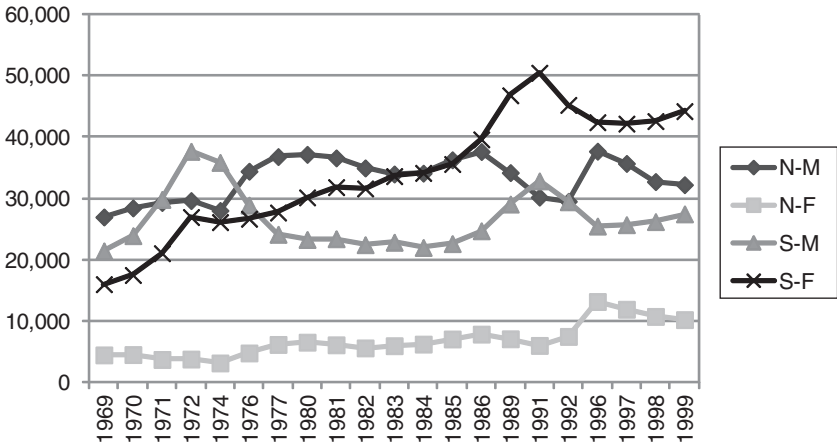
and agriculture disciplines, and are meeting the nation's human resources needs. We will therefore also consider maintaining this ratio with future enrollment growth.

This case demonstrates two important messages: first, the MOE controls university admissions, and second, the MOE determines university admissions based on estimates of future human resources needs. But if, as the MOE official said, the enrollment ratio of the two major areas is about the same, why is the admissions gap between the social studies group and the natural sciences group so large?

First, we examine the numbers of people admitted through the college entrance examination. Figure 1 shows that the natural sciences group indeed consistently had higher college admission rates than the social studies group between 1972 and 1991. In 1972, 1984, and 1992, the respective admission quotas for the natural sciences group were greater than those of the social studies group by 1,785, 4,022, and 1,672 students; 1984 was the peak of the gap in the number admitted.⁶ This gap is related to government policy on academic disciplines. Since the 1960s, Taiwan's economic policy has turned from labor-intensive manufacturing toward technology-intensive high-tech industries. Manpower planning policy has also shifted from an earlier focus on intermediate technological human resources to, more recently, cultivating high-tech talent. This has in turn guided a higher education policy of expanding science and engineering disciplines at a faster rate than humanities disciplines.

With the deregulation of higher education after 1992, a succession of junior colleges upgraded to universities, and most newly established universities were private institutions. The majority of these institutions set up discipline areas with

Figure 2. Numbers Participating in the College Entrance Exam



Notes: N-M—natural sciences-male; N-F—natural sciences-female; S-M—social humanities-male; S-F—social humanities-female.

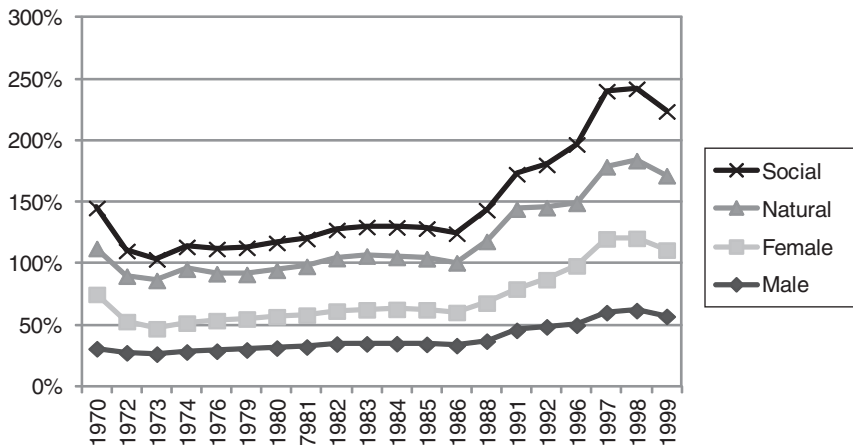
lower set-up investment thresholds, including business and languages. The admission rate of graduates from the social studies group then began to improve gradually and eventually exceeded that of the natural sciences group.

In addition, Figure 2 shows that, prior to 1978, more men than women took the college entrance exam, regardless of whether they were in the natural sciences group or the social studies group (JBCRC 1970–2002). Only after 1978 did the number of women in social studies taking the exam climb dramatically and overtake that of men. Totalling the number of exam candidates, the social studies group has consistently been larger than the natural sciences group. Between the 1989 and 1991, the former grew to 30,000 more than the latter. Not only has the number of students from the natural sciences group been lower; the number of women in that group has been far lower than that of men. The gender ratio of exam candidates from each group clearly reflects a gender gap between the natural sciences group and the social studies group.

Finally, between 1970 and the mid-1990s, the admission rate of the natural sciences group was higher than that of the social studies group, with the largest gap occurring around 1990. The concentrations of women in the social studies group and men in the natural sciences group resulted in women having fewer opportunities for college admission than men. The overall number admitted from the social studies group increased substantially until 1996, when admission rates for the natural sciences and social studies groups, and for men and women, gradually reached parity.

The above historical overview of Taiwan's education system shows that grouping began with the 1954 college entrance examinations, which led to grouping

Figure 3. Percentages Admitted to College Through the Entrance Exam



in high school instruction. Under government human resource planning policies that emphasized economic development and science and technology, university science and engineering disciplines expanded far more rapidly than humanities and social studies. Consequently, during the two decades from 1970 to 1990, more students from the natural sciences group than the social studies group were admitted through the entrance exam (Figure 3). This led to lower admission rates for graduates from the social studies group compared to the natural sciences group, and also resulted in a mindset on the part of some high schools that the former was higher in status than the latter.

Furthermore, because women dominated the social studies group were women and men dominated the natural sciences group, the rate of men admitted through the entrance exam was higher than that of women over the long term. An examination of the history of the system demonstrates that, in addition to traditional gender and cultural influences, economic policies and the education system not only sustained the gender gap that kept men in science and technology and woman in the humanities but also introduced a hierarchical relationship between the disciplines.

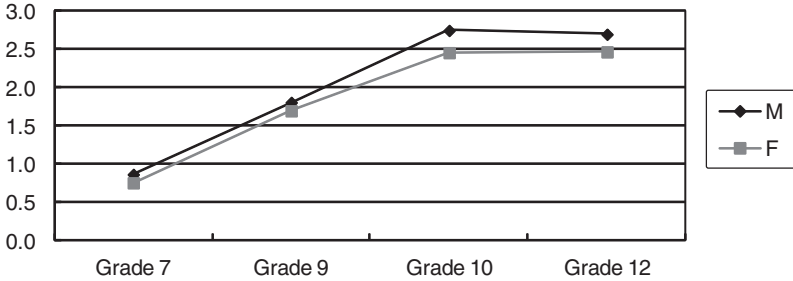
In addition to differences between the groups in the college-bound track, has grouping in college admissions and the high school curriculum had a substantial influence on student learning? We offer further analysis of the survey data from TEPS and the Taiwan Higher Education Database below.

Influence of High School Grouping on Student Learning

High School Grouping and Development of Math Competence

What effect has high school grouping had on student learning? The most significant difference is seen in the mathematics curriculum of the social studies group versus

Figure 4. Analysis by Gender of Math Competence from Junior High to Senior High School, Using TEPS 2007 Survey Samples



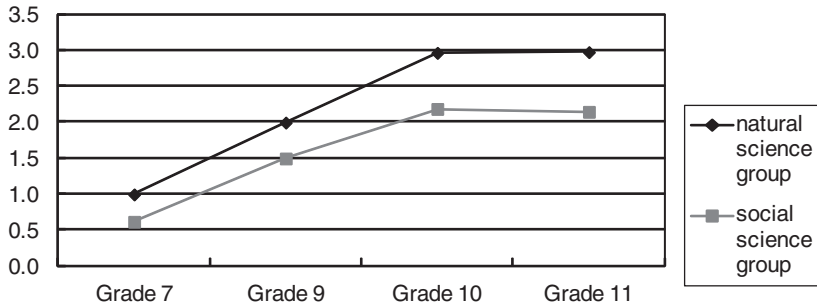
that in the natural sciences group. A student's grades in math are an important consideration for curriculum group selection in high school.

Beginning in 2001, the TEPS conducted follow-up surveys of students in junior high school, senior high school, and vocational high school; four surveys were conducted between 2001 and 2007. The questionnaire contained a set of test questions in a variety of subjects, including general reasoning, science, math, and language to assess the students' capacity for comprehensive analysis. We chose the subject with the most obvious gender difference, mathematical competence, as an indicator. We collated a sample of more than 2,000 students from the four surveys in 2001 (junior high year 1, seventh grade), 2003 (junior high year 3, ninth grade), 2005 (senior high school year 1, tenth grade), and 2007 (senior high school year 3, twelfth grade), to observe changes in math competence between the first year of junior high and the last year of senior high school.⁷

Figure 4 shows that students' mathematical competence improved significantly between the first year of junior high and the first year of senior high, but did not change much between the first and third years of senior high school. On average, the math competence of boys in each grade was significantly higher than that of girls. This gap was significantly greater in senior high than in junior high (0.11 between boys and girls in seventh and ninth grades, rising to 0.29 in the tenth grade). What factors account for the increased disparity in math competence between boys and girls in senior high school?

We compared changes in the math competence of students in the social studies group and the natural sciences group between the seventh and ninth grades. Figure 5 shows that in, the seventh grade, there was already a considerable gap (0.38) between the mathematical competence of students in the natural sciences group and those in the social studies group. By ninth grade, the gap had expanded to 0.50; it increased substantially to 0.78 in the first year of senior high school, tenth grade, and reached 0.83 in the twelfth grade. We can see by combining Figures 4 and 5 that the math competence gap between the social studies group and the natural sciences group is much larger than the gap between the genders. The key factor in

Figure 5. Analysis by Group of Math Competence from Junior High to Senior High School, Using TEPS 2007 Survey Samples



widening mathematical competence gap is therefore very likely to be senior high school grouping.

Senior High School Grouping and the Higher Education Gender Gap

We next ask: What is the relationship between high school grouping and the higher education gender gap?⁸ Higher education in Taiwan began a rapid expansion in the mid-1990s. In 2005, the admission rate on the comprehensive university entrance exam reached 89.1 percent (MOE 2007). According to MOE statistics, in 2005 the proportion of women exceeded 70 percent in the “comprehensive university” disciplines of education, arts, humanities, family and consumer science, and tourism, but included less than 30 percent of students in mathematics, computer science, and engineering, all of which are gender-imbalanced disciplines. The gender composition was more balanced in other disciplines such as social sciences, law, business, medicine, and communications (see Table 1). What are the similarities and differences of students in gender-imbalanced and gender-balanced disciplines?

Taking 2005 freshman students survey data from the Taiwan Higher Education Database System,⁹ we used the gender composition of the disciplines in which students were enrolled to divide them into “female disciplines” (70 percent or more women), “male disciplines” (70 percent or more men), and “neutral disciplines” (no less than 30 percent of either men or women), as presented in Table 2.

In 2005, about half of university students were enrolled in neutral disciplines, 26.6 percent in male disciplines, and 23.5 percent in female disciplines. In terms of high school group, 97 percent of students in male disciplines came from the natural sciences high school group, while 81 percent of students in female disciplines came from the social studies high school group. This demonstrates the powerful influence of high school groups on gender divisions in university disciplines.

Observing the father’s years of education and occupation, we found that the

Table 1

Women in Academic Disciplines, Comprehensive Universities, 2005 (%)

Discipline	Percentage
Education	71
Arts	73
Humanities	72
Economics, Sociology, Psychology	61
Business and Management	60
Law	51
Natural Sciences	31
Engineering	16
Architecture and Urban Planning	52
Agriculture, Forestry, Animal Husbandry and Fisheries	51
Family and Consumer Science	75
Transport and Communications	45
Tourism Services	71
Math and Computer	28

family background of students enrolled in male disciplines was superior to those in neutral and female disciplines. Male disciplines require more equipment, their operating costs are relatively high, and students pay higher tuition and fees, resulting in higher enrollment thresholds.¹⁰ This may explain the higher family socioeconomic status of students in male disciplines, while those from lower socioeconomic backgrounds tend to be in neutral and female disciplines.

The results of the General Scholastic Ability Test (GSAT)¹¹ indicate that students from female disciplines performed the best in Chinese, English, and social studies, with a combined average score of 31.75. Students in male disciplines had the highest overall average in math and the natural sciences (20.07). Combining the scores on five subjects, we found that students in male disciplines had the highest performance overall (50.40), those in neutral disciplines were next (47.25), and those in female disciplines had the lowest (46.87).¹² Under the influence of educational and social values in which higher scores indicate superiority, people are very likely to conclude that male disciplines are superior in status to female disciplines.

The scope of the GSAT included in this survey sample was based on Taiwan's 1995 high school curriculum outline, which required a unified curriculum in years one and two of senior high school, then allowed advanced elective courses in year three. Since aptitudes for disciplines differ, it is reasonable to expect that students from male and female disciplines each have their own strengths and weaknesses

Table 2

Descriptions of Variables Among First-Year Students at Comprehensive Universities, 2005 ($N = 40,164$)

	(1) Neutral (disciplines)	(2) Male disciplines	(3) Female disciplines	Significance analysis
All students (%)	49.9	26.6	23.5	
Male (%)	46	82	22	2 > 1 > 3
Father's years of education	12.43	12.56	12.41	2 > 1 ~ 3
Father's occupation*	3.10	3.17	3.04	2 > 1 > 3
High school Natural Sciences group (%)	46	97	19	
High school Social Studies group (%)	54	3	81	
GSAT score I (Chinese, English, Social Studies)	30.55	30.33	31.75	3 > 1 > 2
GSAT score II (Mathematics, Natural Sciences)	16.70	20.07	15.12	2 > 1 > 3
Individual interests**	3.25	3.26	3.40	3 > 2 ~ 1
Job opportunities**	3.11	3.15	3.09	2 > 1 ~ 3
Private college (%)	66	53	57	1 > 3 > 2

Notes: *1 = agriculture, forestry, animal husbandry, fisheries and unskilled work; 2 = service trades and semiskilled work; 3 = clerical work; 4 = technician and assistant work; 5 = general professional; 6 = senior professional. **The question is "How important is the following factor in your choice of deciding in which discipline to major in college?" The answers were provide in four-level Likert scale: 1 = entirely unimportant; 2 = not very important; 3 = important; 4 = very important.

in social studies versus math, physics, and chemistry. But it is worth noting that the performance gap between the two groups in math, physics, and chemistry is much larger than the gap in social studies.

We believe that differences certainly exist in students' baseline academic competencies, but that the senior high school grouping system may have the result that in math, physics, and chemistry teachers hold different expectations for students in the social studies group compared to the natural sciences group. Their attitudes and teaching methods may then also differ between the two groups. The students themselves may not have the same self-expectations, thereby expanding the math and science learning outcomes gap between the two groups.

In addition, the data show that when students in male disciplines choose their area of study, they place more emphasis on future job opportunities than do students in female disciplines. Furthermore, among the three groups, the male disciplines constituted the lowest percentage of private university students.¹³ This means that students in male disciplines come from more advantaged family backgrounds, perform better on school exams, and pay lower tuition. They also expect to turn what they have learned into an advantage in the job market after graduation.

Conclusion

We have used the historical evolution of Taiwan's education system and data from large-scale educational databases to analyze the association of institutional factors and educational outcomes. Grouping in the college entrance examinations in the 1950s led to grouping in the high school curriculum. Under Taiwan's human resources planning policy between 1970 and the early 1990s, more students were enrolled in science and engineering than in the humanities and social sciences. This resulted in higher entrance exam admission rates for the natural sciences group than for the social studies group for many years, affording the natural sciences higher status than social studies. Large-scale education survey statistics demonstrate that grouping in high school instruction seems to have enlarged the mathematics performance gap between the natural sciences group and the social studies group, and extended to a performance gap between the two groups on the college entrance examination.

Under earlier government human resources policy and resource allocation, science and technology obtained more resources and enjoyed advantages in higher education relative to the humanities and social sciences. After the deregulation of higher education, in the mid-1990s lower-threshold disciplines such as humanities and social studies became more concentrated in private colleges. A higher proportion of the higher-threshold disciplines of science and engineering were located in the national public universities, which had higher social prestige, admitted students with higher entrance exam scores, and received more government funding. Moreover, because more men went into science and engineering, the superiority of those disciplines over the humanities was consolidated along with the social value judgment and stereotype that male fields were better than female fields.

Today, the MOE still controls Taiwan's university admissions quotas, although it has adopted overall caps and no longer mandates the number allocated to each discipline. But grouping in the college entrance examination system since the 1950s has nevertheless had a profound influence on grouping in high school instruction and student learning outcomes. It has maintained the gender gap in colleges and universities and strengthened the hierarchical relationships of gender-dominated disciplines. Given the grouping in high school instruction and in the college entrance exams, along with a gap accumulated over two generations based on family background and individual student performance, it is even more important to take

note of the relationship between the academic discipline gender gap and social class replication.

In response to rapid social developments in the twenty-first century and swift changes in technology and industry, people have begun to discuss the issues of premature tracking in education and the cultivation of overly narrow specialization. Colleges and universities have begun deliberating solutions like postponing the selection of a major. Taiwan's gender equity education policies are also encouraging students to unlearn the traditional gender stereotype. We believe that the premise for improving college education is a thorough review and reform of grouping in two key systems, the college entrance examinations and high school instruction.

In addition, a great deal of research has addressed gender segregation in higher education in Europe and America (Charles and Bradley 2009; Jacobs 1995), but such research in Asia remains to be fully developed. The influence of institutional factors may characterize societies with fierce competition in college-bound students, and this issue is worthy of comparative research.

Notes

1. TEPS (www.teps.sinica.edu.tw/main.htm) is cofunded by the Academia Sinica, the MOE, the Preparatory Office of the National Academy for Educational Research (2004–7), and the National Science Council (2000–2008). The Academia Sinica, Institute of Sociology, and Institute of European and American Studies share responsibility for planning and implementing the long-term national database program. The database started in 2001 and collected data two to four times each year from students who in that year were either in the first year of junior high school or the second year of high school, vocational high school, or junior college, as well as from parents, teachers, and schools. The survey sampled classes as units, accounting for factors such as urban and rural areas to obtain a nationwide representative sample.

2. For example, in 1967, the range of exam scores for admission to the Physics Department at National Taiwan Normal University (NTNU) was 408–43 for men and 394–431 for women (*Jingji shibao* 1967). In 1970, the range of scores for admission to NTNU's History Department was 400–438 for men and 416–41 for women. For Tunghai University's Foreign Languages Department, it was 393–415 for men and 407–23 for women (*Lianhe bao* 1971).

3. Group A was science and engineering, Group B—literature and arts, Group C—medicine and agriculture, and Group D—law and commerce. The common test subjects for all of the groups were Chinese, English, and Sun Yat-Sen's Three Principles of the People. In addition, each had its different test subjects: Group A included physics, chemistry, and "mathematics for natural sciences" (which is more difficult); Group B included history, geography, and "mathematics for social studies" (which is easier); Group C included chemistry, biology, and "mathematics for social studies." Group D's test subjects were the same as Group A's.

4. Category 1 is humanities and social sciences, Category 2 stresses science and engineering, Category 3 stresses biology and medicine, and Category 4 is interdisciplinary.

5. Apart from the different curriculum content, the lab fees for the natural sciences group and the social studies group were not the same in years two and three of high school, indicating that high school grouping was more institutionalized by 1967 (*Lianhe bao* 1967).

6. In 1972, 1984, and 1992, enrollments of graduates from the natural sciences group were 12,217, 17,769, and 25,348, respectively; the numbers of graduates from the social studies

group admitted in those years were 10,432, 13,747. and 23,676 (JBCRC 1970–2002).

7. The public version of the Fourth High School, Vocational, and Postsecondary Student Survey released 13,553 samples, among which 2,939 were follow-up samples.

8. This section is largely adapted from Hsieh, Chen, and Lin (2009).

9. The Taiwan Higher Education Database System (www.cher.ntnu.edu.tw/?cat=6), moderated by Professor Sen-Ming Peng and supported by the MOE and the National Science Council, is a large-scale survey research project supported by rigorous sampling procedures. It regularly surveys nationally representative samples of students and teachers in higher education (Peng 2006).

10. For example, in 2007 the tuition for one undergraduate semester in the School of Arts at National Taiwan University was NT\$25,230; it was NT\$29,470 in the School of Engineering, and NT\$39,560 in the Department of Medicine. There was an even more obvious tuition gap between disciplines in private schools. Studying for a Bachelor of Arts at Tunghai University for one semester cost NT\$47,310, while it was NT\$54,770 in the Engineering Program.

11. The GSAT is part of the college admission procedure. Any student intending to study at a comprehensive university or college is required to take the GSAT. He or she can then use the GSAT score to apply for admission or take another entrance exam for admission.

12. The average mathematics score in male disciplines is 8.63, and 5.52 in female disciplines; the gap for math is nearly as large as that of the overall average score.

13. In Taiwan, private college tuition is approximately twice that of public universities. The Science and Technology Advisory Group (<http://udndata.com.nthulib-oc.nthu.edu.tw/library>) of Taiwan's Executive Yuan (the Cabinet) recommended in 2000 that public university tuition be increased year by year to shrink the gap between public and private tuition.

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